

WHAT IS CLAIMED IS:

1 1. A ferromagnetic semiconductor composition, comprising:
2 a substrate layer; and
3 a ferromagnetic semiconductor epilayer formed on the substrate, said epilayer
4 defining a plane and having a cubic hard axis;
5 wherein a voltage transverse to said cubic hard axis is detectable in response
6 to an applied current flow along the cubic hard axis.

1 2. The composition of claim 1, wherein the application of an in-plane
2 magnetic field, non-aligned with the cubic hard axis, produces a transition in the transverse
3 magnetic resistance of the epilayer.

1 3. The composition of claim 1, wherein the applied in-plane magnetic
2 field is sufficiently strong such that the transition is substantially abrupt.

1 4. The composition of claim 1, wherein the substrate is a GaAs substrate,
2 and wherein the epilayer includes Mn doped GaAs ((Ga, Mn)As)).

1 5. The composition of claim 4, wherein the concentration ratio of Ga to
2 Mn in the epilayer is approximately 948 to 52.

1 6. The composition of claim 4, wherein the concentration ratio of Ga to
2 Mn is between approximately 100:1 and 100:8.

1 7. The composition of claim 1, wherein the substrate is selected from the
2 group consisting of GaAs and GaN.

1 8. The composition of claim 1, wherein the epilayer is selected from the
2 group consisting of Mn doped GaAs and Mn doped GaN.

1 9. The composition of claim 1, wherein the substrate includes a buffer
2 layer formed thereon and disposed between the substrate and the epilayer.

1 10. The composition of claim 9, wherein the buffer layer includes p-type
2 GaAs.

- 1 11. The composition of claim 10, wherein the p-type GaAs is Be doped
2 GaAs.
- 1 12. The composition of claim 10, wherein the epilayer includes Mn doped
2 GaAs.
- 1 13. The composition of claim 12, wherein the buffer layer is
2 approximately 300 nm thick and wherein the epilayer is approximately 150 nm thick.
- 1 14. The composition of claim 1, wherein the epilayer is between
2 approximately 10 nm thick and approximately 350 nm thick.
- 1 15. The composition of claim 1, wherein the epilayer is formed by
2 molecular beam epitaxy.
- 1 16. A ferromagnetic semiconductor device, comprising:
2 a substrate defining a plane;
3 a ferromagnetic semiconductor epilayer formed on said substrate, said epilayer
4 being substantially elongated and oriented along a cubic hard axis; and
5 first and second electrical contacts, each contact coupled to an end of the
6 elongated epilayer, said contacts being configured to provide an electrical current flow along
7 the hard axis;
8 wherein application of an electrical current flow along the hard axis produces
9 a voltage substantially transverse to said hard axis.
- 1 17. The device of claim 16, further including first and second transverse
2 voltage probes coupled at opposite sides of the elongated epilayer, said first and second
3 probes being substantially equidistant from an end of the epilayer, wherein said voltage
4 probes detect said transverse voltage responsive to said current flow.
- 1 18. The device of claim 16, further including a plurality of transverse
2 voltage probe pairs, each pair including a probe coupled at opposite sides of the epilayer,
3 each pair defining a voltage detection region substantially perpendicular to the cubic hard
4 axis.

- 1 19. The device of claim 16, wherein application of an in-plane magnetic
2 field, non-aligned with the cubic hard axis, produces a transition in the transverse magnetic
3 resistance of the epilayer.
- 1 20. The device of claim 19, wherein the applied magnetic field is
2 sufficiently strong such that the transition is substantially abrupt.
- 1 21. The device of claim 16, wherein the substrate is a GaAs substrate, and
2 wherein the epilayer includes Mn doped GaAs ((Ga, Mn)As)).
- 1 22. The device of claim 21, wherein the concentration ratio of Ga to Mn in
2 the epilayer is approximately 948 to 52.
- 1 23. The device of claim 21, wherein the concentration ratio of Ga to Mn is
2 between approximately 100:1 and 100:8.
- 1 24. The device of claim 16, wherein the substrate is selected from the
2 group consisting of GaAs, and Mn doped GaN.
- 1 25. The device of claim 16, wherein the epilayer is selected from the group
2 consisting of Mn doped GaAs and Mn doped GaN.
- 1 26. The device of claim 16, wherein the substrate includes a buffer layer
2 formed thereon and disposed between the substrate and the epilayer.
- 1 27. The device of claim 26, wherein the buffer layer includes p-type GaAs.
- 1 28. The device of claim 27, wherein the p-type GaAs is Be doped GaAs.
- 1 29. The device of claim 27, wherein the epilayer includes Mn doped GaAs.
- 1 30. The device of claim 16, wherein the epilayer is between approximately
2 10 nm thick and approximately 350 nm thick.
- 1 31. The device of claim 16, wherein the epilayer is formed by molecular
2 beam epitaxy.

1 32. A method of measuring magnetic domain wall parameters in
2 ferromagnetic-semiconductor materials, comprising:
3 providing a test sample including a ferromagnetic semiconductor epilayer
4 formed on a substrate, said epilayer being substantially planar and having a cubic hard axis
5 and being substantially elongated;
6 providing a current flow along the cubic hard axis; and
7 detecting a transverse voltage in the epilayer responsive to said current flow at
8 each of a plurality of transverse voltage probe pairs in contact with the epilayer, each pair
9 having probes in contact with the epilayer on opposite sides relative to the cubic hard axis.

1 33. The method of claim 32, further comprising applying an in-plane
2 magnetic field to the test sample.

1 34. The method of claim 33, wherein said applied magnetic field is non-
2 aligned with the cubic hard axis.

1 35. The method of claim 33, wherein the applied field is fixed in
2 magnitude, and wherein applying includes sweeping the orientation of the magnetic field
3 relative to the cubic hard axis.

1 36. The method of claim 35, wherein sweeping includes sweeping the
2 magnetic field by 2π .

1 37. The method of claim 33, further including applying a saturation field to
2 the test sample before applying the in-plane magnetic field.

1 38. The method of claim 34, wherein the applied field is fixed in
2 orientation relative to the cubic hard axis, and wherein the magnitude of the applied magnetic
3 field is altered.

1 39. The method of claim 32, further including processing the transverse
2 voltages detected by the transverse voltage probe pairs so as to determine one or more
3 parameters associated with a magnetic domain wall in the epilayer.

1 40. The method of claim 39, wherein the one or more parameters include
2 one of domain wall velocity and transverse magnetic resistance.

1 41. The method of claim 32, wherein the substrate is a GaAs substrate, and
2 wherein the epilayer includes Mn doped GaAs ((Ga, Mn)As)).

1 42. The method of claim 41, wherein the concentration ratio of Ga to Mn
2 in the epilayer is approximately 948 to 52.

1 43. The method of claim 41, wherein the concentration ratio of Ga to Mn
2 is between approximately 100:1 and 100:8.

1 44. The method of claim 32, wherein the substrate is selected from the
2 group consisting of GaAs and GaN.

1 45. The method of claim 44, the epilayer is selected from the group
2 consisting of Mn doped GaAs and Mn doped GaN.

1 46. The method of claim 32, wherein the sample includes a buffer layer
2 formed between the substrate and the epilayer.

1 47. The method of claim 32, wherein the substrate is a type III-V
2 semiconductor.

1 48. The method of claim 47, wherein the epilayer is a type III-V
2 semiconductor doped with Mn.

1 49. The composition of claim 1, wherein the substrate is a type III-V
2 semiconductor.

1 50. The composition of claim 49, wherein the epilayer is a type III-V
2 semiconductor doped with Mn.

1 51. The device of claim 16, wherein the substrate is a type III-V
2 semiconductor.

1 52. The device of claim 51, wherein the epilayer is a type III-V
2 semiconductor doped with Mn.